SINGLE CORRECT TYPE QUESTIONS

Photoelectric Effect :

1. **Statement 1** : Photoelectric effect establishes quantum nature of light.
and
Statement 2 : There is negligible time lag between photon collisions with the material and photoelectron emission irrespective of intensity of incident light. (Assume incident light is of frequency greater than threshold frequency of the material).
(A) Statement-1 is true, statement-2 is true and statement-2 is correct explanation for statement-1.
(B) Statement-1 is true, statement-2 is true and statement-2 is NOT the correct explanation for statement-1.
(C) Statement-1 is true, statement-2 is false.
(D) Statement-1 is false, statement-2 is true.

2. **Statement-1 :** Work function of aluminum is 4.2 eV. If two photons each of energy 2.5 eV strikes on a piece of aluminum, the photo electric emission does not occur
Statement-2 : In photo electric effect a single photon interacts with a single electron and electron is emitted only if energy of each incident photon is greater then the work function.
(A) Statement-1 is True, Statement-2 is True, Statement-2 is a correct explanation for statement-1
(B) Statement-1 is True, Statement-2 is True, Statement-2 is NOT a correct explanation for Statement-1
(C) Statement-1 is True, Statement-2 is False
(D) Statement-1 is False, Statement-2 is True

3. A photocell is illuminated by a small bright source placed 1 m away. When the same source of light is place $\frac{1}{2}$ m away, the number of electrons emitted by photocathode would- **[AIEEE - 2005]**
(A) decrease by a factor of 4
(B) increase by a factor of 4
(C) decrease by a factor of 2
(D) increase by a factor of 2

4. Two monochromatic light sources, A and B, emit the same number of photons per second. The wavelength of A is $\lambda_A = 400$ nm, and that of B is $\lambda_B = 600$ nm. The power radiated by source B is
(A) equal to that of source A
(B) less than that of source A
(C) greater than that of source A
(D) cannot be compared to that from source A using the available data.

5. The energy flux of sunlight reaching the surface of the earth is 1.388×10^3 W/m^2. How many photons (nearly) per square metre are incident on the Earth per second? Assume that the photons in the sunlight have an average wavelength of 550 nm. **NCERT**
(A) 8×10^{21} (B) 4×10^{21} (C) 4×10^{38} (D) 8×10^{38}

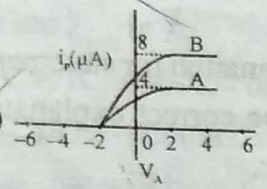
6. The threshold frequency for a certain metal is 3.3×10^{14} Hz. If light of frequency 8.2×10^{14} Hz is incident on the metal, the cutoff voltage for the photoelectric emission is. **NCERT**

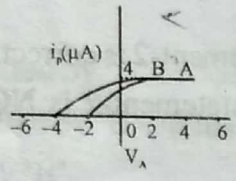
(A) 8 V (B) 6 V (C) 2 V (D) 4 V

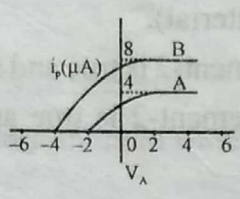
7. Light of frequency 7.21×10^{14} Hz is incident on a metal surface. Electrons with a maximum speed of 6.0×10^5 m/s are ejected from the surface. The threshold frequency for photoemission of electrons is **NCERT**

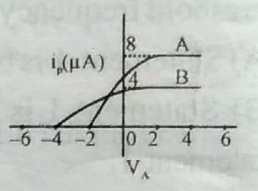
(A) 4.73×10^{14} Hz (B) 4.73×10^{10} Hz (C) 2.08×10^{10} Hz (D) None of these

8. In a photoelectric effect experiment, photons of energy 5 eV are incident on the photo-cathode of work function 3 eV. For photon intensity $I_A = 10^{15}\ m^{-2}s^{-1}$, saturation current of 4.0 μA is obtained. Sketch of the variation of photocurrent i_p against the anode voltage V_a for photon intensity I_A (curve A) and $I_B = 2 \times 10^{15}\ m^{-2}\ s^{-1}$ (curve B) will be:

(A) 

(B) 

(C) 

(D) 

9. **Statement-1 :** When ultraviolet light is incident on a photocell, its stopping potential is V_0 and the maximum kinetic energy of the photoelectrons is K_{max}. When the ultraviolet light is replaced by infrared light, both V_0 and K_{max} increase.

Statement-2 : Photoelectrons are emitted with speeds ranging from zero to a maximum value.

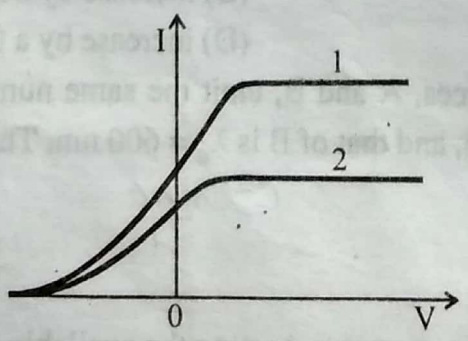
(A) Statement–1 is true, Statement–2 is false

(B) Statement–1 is true, Statement–2 is true; Statement–2 is the correct explanation of Statement–1

(C) Statement–1 is true, Statement–2 is true; Statement–2 is not the correct explanation of Statement–1

(D) Statement–1 is false, Statement–2 is true

10. A photocathode can be illuminated by the light from two sources, each of which emits monochromatic radiation. The sources are positioned at equal distances from the photocathode. The dependence of the photocurrent on the voltage between the cathode and the anode is depicted by curve 1 for one source and by curve 2 for the other. In what respect do these **sources** differ ?



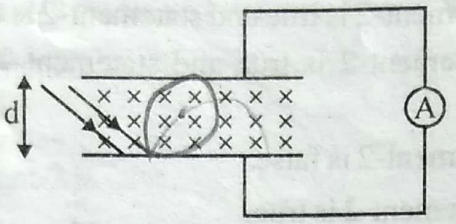
(A) Highest frequency photon

(B) Number of photons emmited per second

(C) Number of photoelectrons emmited per second

(D) None of these

11. In an experiment on photoelectric effect, the emitter and the collector plates are placed at a separation d and are connected through an ammeter without any cell. A magnetic field B exists parallel to the plates (as shown). The work function of the emitter is ϕ and light incident on it has wavelength λ. Then the minimum value of B for which ammeter registers zero current will be (Take mass of electron as m and charge on it is e)



(A) $\frac{1}{2d}\sqrt{m\left(\frac{hc}{\lambda}-\phi\right)}$ (B) $\frac{2}{ed}\sqrt{2m\left(\frac{hc}{\lambda}-\phi\right)}$ (C) $\frac{1}{ed}\sqrt{m\left(\frac{hc}{\lambda}-\frac{\phi}{2}\right)}$ (D) $\frac{2}{ed}\sqrt{m\left(\frac{2hc}{\lambda}-\phi\right)}$

12. A radiation of energy E falls normally on a perfectly reflecting surface. The momentum transferred to the surface is- **[AIEEE - 2004]**

(A) E/c (B) 2E/c (C) Ec (D) E/c^2

Wave Nature oF Matter :

13. **Statement-1 :** If an electron has the same wavelength as a photon, they have the same energy.
Statement-2 : by debroglie hypothesis, $p = h/\lambda$ for both the electron and the photon.

(A) Statement-1 is true, statement-2 is true and statement-2 is correct explanation for statement-1.

(B) Statement-1 is true, statement-2 is true and statement-2 is NOT the correct explanation for statement-1.

(C) Statement-1 is true, statement-2 is false.

(D) Statement-1 is false, statement-2 is true.

14. A particle of mass 4m at rest decays into two particles of masses m and 3m having non-zero velocities. The ratio of the de-Broglie wavelengths of the particles 1 and 2 is

(A) $\frac{1}{2}$ (B) $\frac{1}{4}$ (C) 2 (D) 1

15. A free particle with initial kinetic energy E and de–broglie wavelength λ enters a region in which it has potential energy U. What is the particle's new de–Broglie wavelength?

(A) $\lambda(1-U/E)^{-1/2}$ (B) $\lambda(1-U/E)$ (C) $\lambda(1-E/U)^{-1}$ (D) $\lambda(1+U/E)^{1/2}$

16. A proton has kinetic energy E = 100 keV which is equal to that of a photon. The wavelength of photon is λ_2 and that of proton is λ_1. The ratio of λ_1 / λ_2 is proportional to **[JEE-2004 (Scr.)]**

(A) E^2 (B) $E^{1/2}$ (C) E^{-1} (D) $E^{-1/2}$

17. Proton, deutron and α particles are accelerated through the same potential difference. Then the ratio of their de-Broglie wavelength as

(A) $1:\sqrt{2}:1$ (B) 1 : 1 : 1 (C) $1:2:2\sqrt{2}$ (D) $2\sqrt{2}:2:1$

18. **Statement-1 :** An electron and a proton are accelerated through the same potential difference. The de-Broglie wavelength associated with the electron is longer.

Statement-2 : De-Broglie wavelength associated with a moving particle is $\lambda = \frac{h}{p}$ where, p is the linear momentum and both have same KE.

(A) Statement-1 is true, statement-2 is true and statement-2 is correct explanation for statement-1.

(B)Statement-1 is true, statement-2 is true and statement-2 is NOT the correct explanation for statement-1.

(C) Statement-1 is true, statement-2 is false.

(D) Statement-1 is false, statement-2 is true.

19. An α-particle of energy 5 MeV is scattered through 180° by a fixed uranium nucleus. The distance of the closest approach is of the order of- **[AIEEE-2004]**

(A) 1 Å (B) 10^{-10} cm (C) 10^{-12} cm (D) 10^{-15} cm

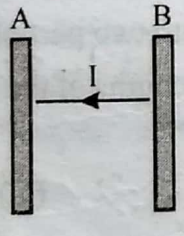
20. After absorbing a slowly moving neutron of mass m_N (momentum ~0) a nucleus of mass M breaks into two nuclei of masses m_1 and $3m_1 (4m_1 = M + m_N)$, respectively. If the de Broglie wavelength of the nucleus with mass m_1 is λ, then de-Broglie wavelength of the other nucleus will be:-

(A) 9λ (B) 3λ (C) $\frac{\lambda}{3}$ (D) λ

21. A laser gun of power 3 mW and mass 50 gm emits photons of wavelength 500 nm. It is in gravity free space and emits for one hour. Find the distance covered by gun due to recoil in this one hour (approx.):-

(A) 1.3 mm (B) 2.1 μm (C) 1.1 cm (D) 8.5 mm

22. A parallel beam of light of intensity I is incident normally on a plane surface A which absorbs 50% of the incident light. The reflected light falls on B which is perfect reflector, the light reflected by B is again partly reflected and partly absorbed and this process continues. For all absorption by A, asborption coefficient is 0.5. The pressure experienced by A due to light is :-



(A) $\frac{1.5\,I}{c}$ (B) $\frac{I}{c}$ (C) $\frac{3I}{2c}$ (D) $\frac{3I}{c}$

Bohr's Theory :

23. The de-Broglie wavelength of an electron in the first Bohr orbit is

(A) equal to the circumference of first orbit (B) equal to $\frac{1}{2}\times$ (circumference of first orbit)

(C) equal to $\frac{1}{4}\times$ (circumference of first orbit) (D) equal to $\frac{3}{4}\times$ (circumference of first orbit)

24. **Statement–1** : When light is passed through a sample of hydrogen atoms in ground state, then wavelengths of absorption lines are same as wavelengths of lines of Lyman series in emission spectrum.

and

Statement–2 : In ground state hydrogen atom will absorb only those radiation which will excite to higher energy level.

(A) Statement-1 is true, statement-2 is true and statement-2 is correct explanation for statement-1.

(B) Statement-1 is true, statement-2 is true and statement-2 is NOT the correct explanation for statement-1.

(C) Statement-1 is true, statement-2 is false.

(D) Statement-1 is false, statement-2 is true.

25. **Statement-1 :** In a laboratory experiment, on emission from atomic hydrogen in a discharge tube, only a small number of lines are observed whereas a large number of lines are present in the hydrogen spectrum of a star.

Statement-2 : The temperature of discharge tube is much smaller than that of the star.

(A) Statement-1 is True, Statement-2 is True, Statement-2 is a correct explanation for statement-1

(B) Statement-1 is True, Statement-2 is True, Statement-2 is NOT a correct explanation for Statement-1

(C) Statement-1 is True, Statement-2 is False

(D) Statement-1 is False, Statement-2 is True

26. If the binding energy of the electron in a hydrogen atom is 13.6 eV, the energy required to remove the electron from the first excited state of Li^{2+} is- **[AIEEE - 2003]**

(A) 30.6 eV (B) 13.6 eV (C) 3.4 eV (D) 122.4 eV

27. A neutron having kinetic energy 13.6 eV collides with a hydrogen atom in ground state at rest. Assume that the mass of neutron and hydrogen atoms are same and the neutron does not leave its line of motion. Then which of the following is the possible KE of the neutron after the collision?

(A) zero (B) 3.4 eV (C) 1.5 eV (D) 6.8 eV.

28. In the spectrum of single ionised helium, the wavelength of a line observed is almost the same as the first line of Balmer series of hydrogen. It is due to transition of electron from

(A) $n_1 = 6$ to $n_2=4$ (B) $n_1 = 5$ to $n_2=3$ (C) $n_1 = 4$ to $n_2 =2$ (D) $n_1 = 3$ to $n_2 =2$

29. Light coming from a discharge tube filled with hydrogen falls on the cathode of the photoelectric cell. The work function of the surface of cathode is 4eV. Which one of the following values of the anode voltage (in Volts) with respect to the cathode will likely to make the photo current zero.

(A) – 4 (B) – 6 (C) – 8 (D) – 10

30. According to Bohr model, magnetic field at the centre (at the nucleus) of a hydrogen atom due to the motion of the electron in n^{th} orbit is proportional to

(A) $1/n^3$ (B) $1/n^5$ (C) n^5 (D) n^3

31. A photon of 10.2 eV energy collides with a hydrogen atom in ground state inelastically. After fe microseconds one more photon of energy 15 eV collides with the same hydrogen atom. Then wha can be detected by a suitable detector. [JEE' 2005 (Scr)

(A) one photon of 10.2 eV and an electron of energy 1.4 eV

(B) 2 photons of energy 10.2 eV

(C) 2 photons of energy 3.4 eV

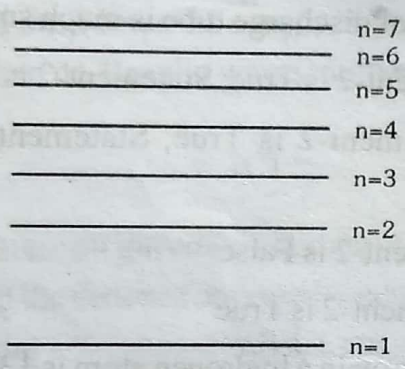
(D) 1 photon of 3.4 eV and one electron of 1.4 eV

32. Two hydrogen atoms are in excited state with electrons residing in n = 2. First one is moving towards left and emits a photon of energy E_1 towards right. Second one is moving towards left with same speed and emits a photon of energy E_2 towards left. Taking recoil of nucleus into account during emission process

(A) $E_1 > E_2$ (B) $E_1 < E_2$

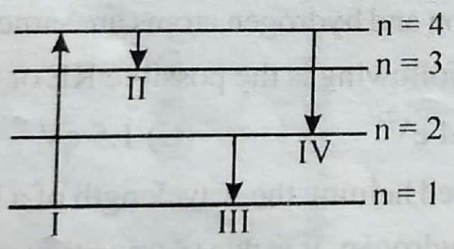
(C) $E_1 = E_2$ (D) information insufficient

33. The maximum number of emission lines for atomic hydrogen that you would expect to see with naked eye if the only electronic levels involved are those shown in the figure, is



(A) 6 (B) 5 (C) 21 (D) ∞

34. The diagram shows the energy levels for an electron in a certain atom. Which transition shown represents the emission of a photon with maximum wavelength?

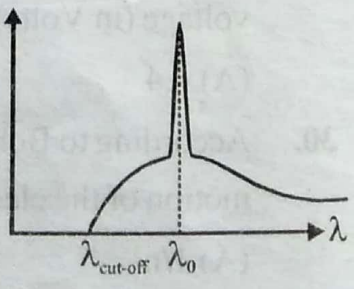


(A) III (B) IV (C) I (D) II

X-Rays :

35. **Assertion (A):** Variation of intensity of X-rays is plotted against λ. On increasing the accelerating potential, $(\lambda_0 - \lambda_{cut\text{-}off})$ increases.

Reasoning (R): $\lambda_{cut\text{-}off}$ will decrease but λ_0 will be same, as wavelength of characteristic X-rays is independent of the accelerating potential.



Choose the correct statement from the following.

(A) A is correct and R is the correct explanation of A.

(B) Both A and R are correct but R is not the correct explanation of A.

(C) A is correct but R is wrong.

(D) Both A and R are wrong.

36. An X-ray tube is run at 50 kV. The current flowing in it is 20mA. The power of the tube is :

(A) 1000 W (B) 200 W (C) 20000 W (D) 20 W

37. Choose the **INCORRECT** statement.

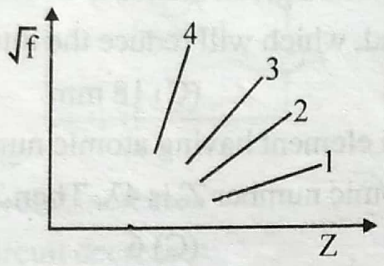
(A) Cut-off wavelength of X-rays is independent of filament voltage.

(B) Presence of K_α-line in X-ray spectrum means that L-series will also be present.

(C) Increase in filament current increases intensity of X-ray.

(D) Presence of L-series in X-ray spectrum means that K-series will also be present.

38. The given graph shows the variation of $\sqrt{f}$ vs Z for characteristics X-rays. Lines 1, 2, 3, 4 shown in the graph corresponds to any one of k_α, k_β, L_α, L_β. Then L_β is represent by :-



(A) line 1 (B) line 2 (C) line 3 (D) line 4

39. The X-ray beam coming from an X-ray tube will be

(A) monochromatic

(B) having all wavelengths smaller than a certain maximum wavelength

(C) having all wavelengths larger than a certain minimum wavelength

(D) having all wavelengths lying between a minimum and a maximum wavelength

40. E_1 is energy of k_α photon of aluminium, E_2 is energy of k_β photon of aluminium and E_3 is energy of k_α photon from sodium, then the correct order of energies is given

(A) $E_1 > E_2 > E_3$ (B) $E_3 > E_2 > E_1$ (C) $E_3 > E_1 > E_2$ (D) $E_2 > E_1 > E_3$

41. The K,L and M energy levels of platinum lie roughly at 78, 12 and 3 keV respectively. The ratio of wavelength of K_α line to that of K_β line in X-ray spectrum is-

(A) $\frac{22}{3}$ (B) $\frac{3}{22}$ (C) $\frac{22}{25}$ (D) $\frac{25}{22}$

42. What is the essential distinction between X–rays and γ–rays

(A) γ–rays have shorter wavelength than X–rays

(B) γ–rays are extraterrestrial, X–rays are man–made

(C) γ–rays have less penetrating power than X–rays

(D) γ–rays originate from within an atomic nucleus, X–rays from outside an atomic nucleus.

43. White X-rays are called "White" because :

(A) they are produced most abundantly in X-ray tubes

(B) they are electromagnetic waves and hence have a nature similar to white light.

(C) they can be converted to visible light using coated screens, and they affect photographic plates, just like white light.

(D) they have a continuous range of wavelengths.

44. Mosley law relates :

(A) Frequency of emitted X-ray with applied voltage

(B) Wavelength and intensity of X-ray.

(C) Frequency of emitted X-ray with atomic number

(D) Wavelength and angle of scattering.

45. The intensity of gamma radiation from a given source is I. On passing through 36 mm of lead, it is reduced to I/8. The thickness of lead, which will reduce the intensity to I/2 will be- **[AIEEE-2005]**

(A) 6 mm (B) 9 mm (C) 18 mm (D) 12 mm

46. The wavelength of K_α X-ray of an element having atomic number Z = 11 is λ . The wavelength of K_α X-ray of another element of atomic number Z' is 4λ. Then Z' is **[JEE' 2005 (Scr)]**

(A) 11 (B) 44 (C) 6 (D) 4

47. Characteristic X-ray

(A) Have only discrete wavelength which are characteristic of the target.

(B) Have all the possible wavelength.

(C) Are characteristic of speed of projectile electrons.

(D) None

MULTIPLE CORRECT TYPE QUESTIONS

48. Photoelectric effect supports quantum nature of light because

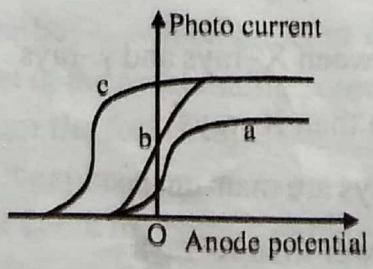
(A) there is minimum frequency of light below which no photoelectrons are emitted

(B) the maximum kinetic energy of photo-electrons depends only on the frequency of light and not on its intensity

(C) even when the metal surface is faintly illuminated, the photoelectrons leave the surface immediately

(D) electric charge of photo-electrons is quantized

49. The figure shows the variation of photo current with anode potential for a photosensitive surface for three different radiations. Let I_a, I_b and I_c be the intensities and f_a, f_b and f_c be the frequencies for the curves a, b and c respectively. Choose correct options



(A) $f_a = f_b$ (B) $I_a < I_b$ (C) $f_c < f_b$ (D) $I_c > I_b$